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ABSTRACT

Noting the tendency for some researchers to reject communication network analysis because the original data might be self-reports, this paper proposes automated network analysis as a means of circumventing such objections. The paper first identifies seven different approaches to defining networks--(1) objective, (2) analyzed, (3) user perceived, (4) recalled, (5) socially synthetic, (6) user projected, and (7) desired. It then discusses the advantages, as well as disadvantages, of automated network analysis. To illustrate possible forms and uses of automated network analysis, the paper next offers five different kinds of analysis: telephone networks, audio conference, computer conference, computer messaging traffic, and media representations of networks. It concludes with a discussion of issues concerning automated network analysis at the theoretical, methodological, and practical levels. (FL)

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AUTOMATED NETWORK ANALYSIS:

A Survey of Different Approaches to the Analysis of Human Communication Relationships

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INTRODUCTION

Computer-based communication technologies offer the means to avoid the "Bernard and Killworth" syndrome. This is the tendency for some readers of their work (in its own ways limited) to automatically reject communication network analysis, because the original data may be self-reports. "Objective" communication network data can increasingly be automatically obtained via recording technologies such as computer, audio, video, or print. On a broad scale, such automated network analysis clarifies a range of possible perspectives on the analysis of communication patterns. Figure 1 summarizes these. A number of them have been stimulated by the television content analysis work of Newcomb (1979) and his students.

First of all, there is the "objective" network as "observed by" computer software, which in many cases is an automatic monitor of all interactions on a computer system (Rice and Borgman, 1983). Note however, that these data are not objective in a classical sense. They only capture what communication actually occurred from perspectives of the recording procedures used. Because the computer software that obtains automated records is a product of human decision-making, usually among a group of systems designers, such procedures are intersubjective. Realizing the epistimological problems, we will nevertheless, refer to this as the "objective network."

Second, there is the network as observed by the analyst. Typically he or she makes certain choices as to the parameters for filtering automated records and setting thresholds as to what constitutes a meaningful interaction. For example, in network records of telephone calls, should calls of duration less than one minute be counted? less than 10 seconds? The network

Figure 1. Seven Ways to Represent Communication Networks

NETWORK	DEFINITION
1) Objective:	Recorded by an automated device, such as a computer program that monitors communication traffic on computer or telephone systems.
2) Analyzed:	Results from the analyst's filtering of the objective traffic record through parameters and thresholds he or she sets.
3) User Perceived:	Cognized by the participants as the interactions take place, and are typically recorded by them in a log.
4) Recalled:	Remembered by network participants sometime after interactions have taken place.
5) Socially Synthetic:	Constructed by non-scientific observers such as journalists, or organizational members who are not nodes within the network of interest.
6) User Projected:	What a member of or segment of the network thinks the traffice structure is like in other parts of the network with which they are not directly involved. In other words, this is users' estimates of 2-step links, 3-step links, etc.
7) Desired:	Preferred by network members, managers, or observers, regardless of actual communication patterns. In other words, the "wished for" network.

as observed via the analyst's parameter settings constitutes the "analyzed network."

Third is the network as recorded by the participants in the communication system, virtually as interactions happen. This is the "user perceived network". Such records could be obtained by asking individuals to log their communication traffic as it happens. Fourth is the "recalled network," which is what individuals report sometime after the interaction has taken place.

Fifth is the reconstructed or "socially synthetic network," the product of observers' representations of it, and typically informally synthesized from several of the preceding kinds of networks. For example, such networks are often observable in newspaper stories, the product of reporters and editors' syntheses of relationships among social system actors.

Sixth, is the "user projected network." This is what network participants think the traffic in other parts of the network (ones which they may not connect with directly) may be like. Seventh is the "desired network." This is the pattern of interactions which participants or observers would like to take place. For example, communication managers may have certain mental representations of networks that they hope occur, or they attempt to manage. Other users may have similar or quite different desired network images.

Specification of these seven different representations of the "same" network in automated or other kinds of communication network analysis, suggests that researchers should clearly communicate about with which networks they are dealing. Thus, automated network analysis has a meta-analysis value in drawing attention to these different ways of framing investigations. Other advantages of automated network analysis are more methodological. Figure 2 summarizes these.

Figure 2. Features of Automated Network Analysis

FEATURE	DESCRIPTION
1) Efficient:	Interactions or communication "traffic" records can be obtained by computer programs that log all interactions over time with little analyst intervention.
2) Complete:	All interactions can be obtained, avoiding problems of user recall, misrepresentation, or alternative cognitive framing.
3) Unobtrusive:	Records are captured without visible evidence to users. Although some users know about monitoring, they may not behave reactively because of the transparency of monitoring and its constancy over time.
4) Alternative Time Framing Flexibility:	The analyst can explore different ways of setting time interval widths for analysis, because records are typically coded via software down to the level of seconds or lower. Wider time slices can be easily set.
5) Time-series analysis:	With capabilities to set relatively small time interval widths, analysts can perform time-series analysis to investigate network evolution.
6) Content analysis:	Some automated monitoring also captures all message content. For public computer conferences and bulletin boards, there is little ethical uncertainty. For "private" messaging ethical issues arise.
7) Cross-method analysis:	Because automated network analysis is efficient, complete, etc., the analyst has more opportunity to investigate theoretical relationships of network to other variables, indexed through methods such as content analysis, surveys, experiments, etc.

One feature is the obvious efficiency involved in obtaining automated records of network activity. Automated data collection typically requires little intervention by the analyst once the collection process is started. The program simply monitors and stores what the analyst tells it to, and all that may be necessary is a periodic dumping of accumulating traffic files into tape archives. In addition, records are complete representations of behaviors within the context of the observational software, except for infrequent hardware or software errors (or more frequent, but manageable human errors).

Another advantage of automated network analysis is that it is often unobtrusive. Many users do not know that computer systems systematically keep records of their online interactions. On some systems every key stroke, errorful or otherwise, is captured and stored, while users are not informed of this as a matter of course. Other users may be aware of automated monitoring procedures, but may become desensitized to them. I have informally observed that many users aware of monitoring say things in computer messages that they would not say in public, even with an informal group. Yet, their computer content as well as traffic may be fully recorded and securely archived indefinately by system managers. This may be whether messages were privately sent to one other user, or publicly entered into a group computer conference or bulletin board.

Another methodological advantage of automated network traffic is enabling alternative time frames for the analysis. In contrast, one of the features of most self-report traffic is that the analyst must choose a single broad time frame, such as "in the last six months," or "usually," etc., and then cannot disaggregate traffic reports within the broad interval selected, which may also be quite fuzzy. Automated traffic analysis enables virtually unlimited

alternative time-framing. Records typically code the communication episodes down to the level of seconds or lower. The analyst has full freedom to try different time interval widths for aggregating frames. This leads to a related advantage, that of performing sophisticated time-series analysis of communication networks, as they evolve.

Because of these conceptual and methodological features of automated communication network analysis, there are rich opportunities for hypothesis testing. Nevertheless, there is the typical danger of the method dominating the theoretical thinking, perhaps almost to its exclusion. But, this seems more characteristic of early development of a particular method. As normal evolution of it proceeds, there is less "little boy [or girl] with the hammer" syndrome (Kaplan, 1964).

METHODOLOGICAL EXAMPLES

The remainder of this paper will present five examples of the use of automated network analysis. The objectives are to show some of the diversity of possibilities. Each example could merit its own paper, but given the current objectives, the reporting of each will be telescoped. To help show possible uses, a brief rationale, including purposes, questions or hypotheses, will be provided. Nevertheless, the analyses reported should be taken as illustrative only, and not as the basis for knowledge claims. Heavy reliance will be made on tables and graphs to economize in presentation. The kinds of communication behaviors to be examined include:

- o intraorganizational station-to-station telephone traffic.
- o an audio conference of members of a research team and the client organization.
- o a public group computer conference with members of a professional association.
- o private computer messaging in a large organization.

o networks of interorganizational relationships as represented in national newspaper stories.

Each of these will illustrate a different kind of automated network analysis. None has been previously presented elsewhere.

Although not centrally relevant to this methodologically oriented paper, most of the projects reported were driven by a theoretically based research program. This program centers on understanding the relationships between communication network structure and the diversity of messages exchanged within these networks. In all examples presented except the first one (telephone network analysis), this is the primary theoretical concern. Given the methodological focus of this paper, however, these theoretical motives are incidental and will not be described in detail.

TELEPHONE NETWORKS

This first example shows a kind of automated network analysis that can be applied to organizational telephone communication. It can also be applied to broader communities such as residential households, in that phone companies are increasingly collecting this kind of traffic information (although are reluctant to make it available to outside investigators). With privately obtained data there are opportunities for theoretical and practical research.

In the present case, in order to test time-series hypotheses about the diversity of environmental linkage and intraorganizational network density, the author arranged research support from a telephone auditing service agency in 1978. This agency typically monitors long distance calling by their client organization members and provides monthly reports for cost control purposes. At the author's request, the computerized telephone monitoring device that the audit agency usually attached to client organizations' Private Branch Exchange

(PBX telephone system) was specifically programmed to save internal station-to-station call records, along with external call records. Typically, only outgoing long-distance calls are recorded.

In this study, however, all internal and outgoing traffic was recorded as to what numbers called what numbers, for what length of time, over 11 days. 399 telephone stations were monitored, with each station as the unit of analysis. In the current example, only internal station-to-station calls were investigated, although the external call records are available.

One particular analysis was done to check the assumption made in most boundary spanning research that the "key intraorganizational communicators" (Tushman, 1977) are those individuals that are in the top 20% of the overall volume of internal communication distribution, without regard to actual network patterns. We wanted to see if using telephone records, one would find that those nodes within the top 20% of the total call duration distribution would actually be "key communicators" in terms of their position in the intraorganizational network. "Key" was operationalized as node integration. This is the extent to which the nodes with which a particular node communicates in turn communicate with one another. The lower the integration, controlling for the number of links, the more "key" the node.

We selected for analysis only links with total durations of 5 minutes or more over 11 days. The 5 minute threshold was arbitrary. In addition, we mapped only nodes with at least three links, so that integrativeness scores would be meaningful and valid. The NEGOPY program (Richards, 1982) on a University of Wisconsin computer was used to index integration of each node and to generate the aggregated communication duration values. These data were in turn entered into SPSS and correlations were performed between integration and a variable indexing whether a node was in the top 20% of call duration.

Table 1. Correlations Between Internal Telephone Network Integration and Volume of Calling: A Test of the Tushman-Tichy Assumption

	NODE INTERGRATION*
TOP 20% OF TOTAL CALL DURATION (Dummy coded: 1=top 20%, 0=not)	-.09
TOP 20% OF TOTAL NODES CALLED (Dummy coded: 1=top 20%, 0=not)	-.08
TOTAL CALL DURATION (Continuous variable)	-.05
TOTAL NODES CALLED (Continuous variable)	-.02
TOP 20% OF TOTAL CALL DURATION PARTIALLING NUMBER OF TOTAL NODES CALLED	-.10

(n=188)

*Computed only for nodes with at least three links.

Table 1 shows the results. There is little evidence that nodes in the top 20% of the overall communication volume distribution are more "key," that is less integrated, or in other words, have more "radial" networks (Laumann, 1973). This suggests that actual network position may be a more useful measure of how "key" a node is in an organizational or other network than only whether the node has a high volume of communication. This example illustrates an advantage in using automated network analysis for possible hypothesis testing and practical communication segmentation for internal information campaigns.

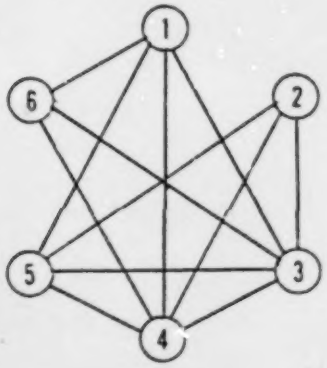
AUDIO CONFERENCE

The second example is a network analysis of an audio conference held among two groups working on an evaluation research project in 1982. One group was comprised of students, a research assistant, Ilya Adler, and the instructor (the author). The other group was constituted by two members of the client organization. Each group was in a different room, some 150 miles away. The purpose of the audio conference was to complete final planning for a research project the students were doing for the client about programming exchange and internal network structure among public access cable organizations across the nation. Audio tape recordings were made of the conference. As an extra credit project, one of the students, Don Schutt, did a network analysis of actors. His purpose was to gain experience in procedures of network analysis, and to examine node integration and message content diversity. Only descriptive data are presented here. See Figure 3.

COMPUTER CONFERENCE

The third example is of a group computer conference. Last spring, members of the Human Communication Technology Interest Group held a two week con-

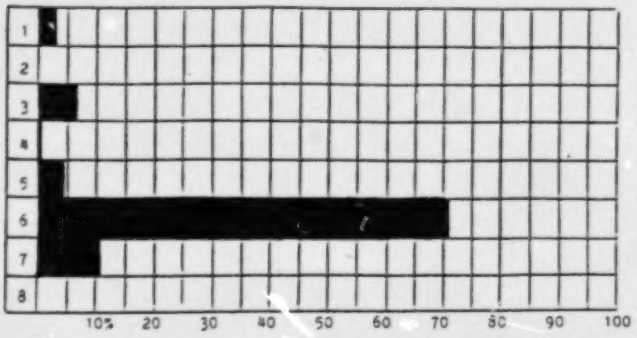
Figure 3. Audio Teleconferencing Network and Bales Interaction Profiles of Participants.



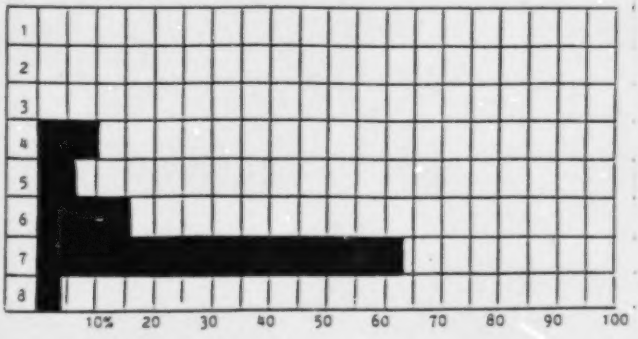
Bales Category KEY:

1. Shows solidarity
2. Shows tension release
3. Agrees
4. Gives suggestion
5. Gives opinion
6. Gives orientation
7. Asks for orientation
8. Asks for opinion

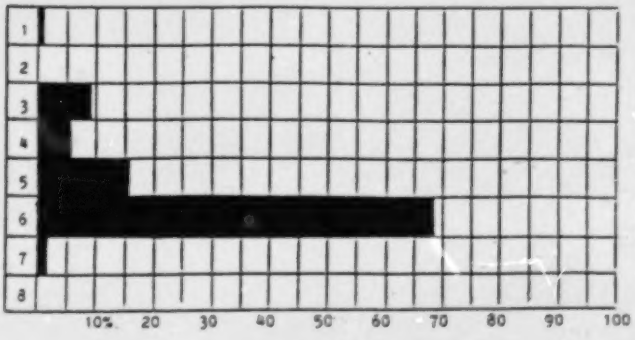
Categories 9-12 did not occur in this teleconference: Asks for suggestion, Disagrees, Shows tension, Shows antagonism.



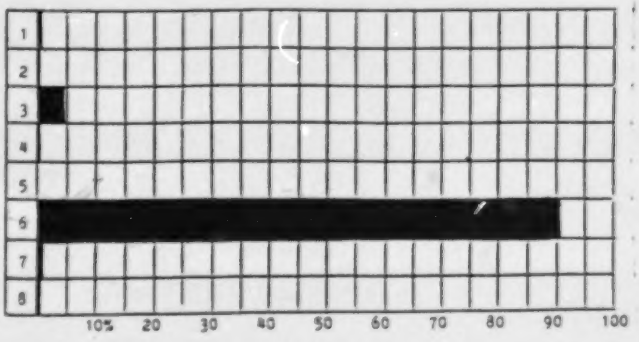
SPEAKER 1 PROFILE



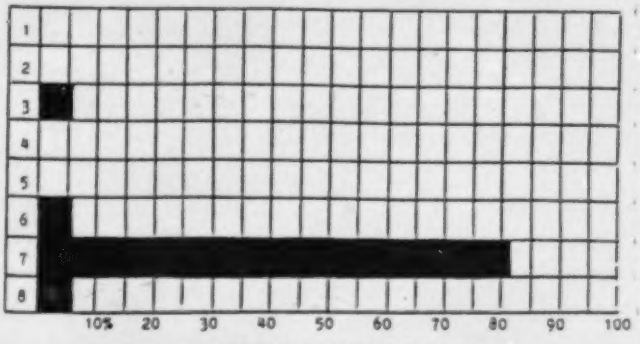
SPEAKER 2 PROFILE



SPEAKER 3 PROFILE



SPEAKER 4 PROFILE



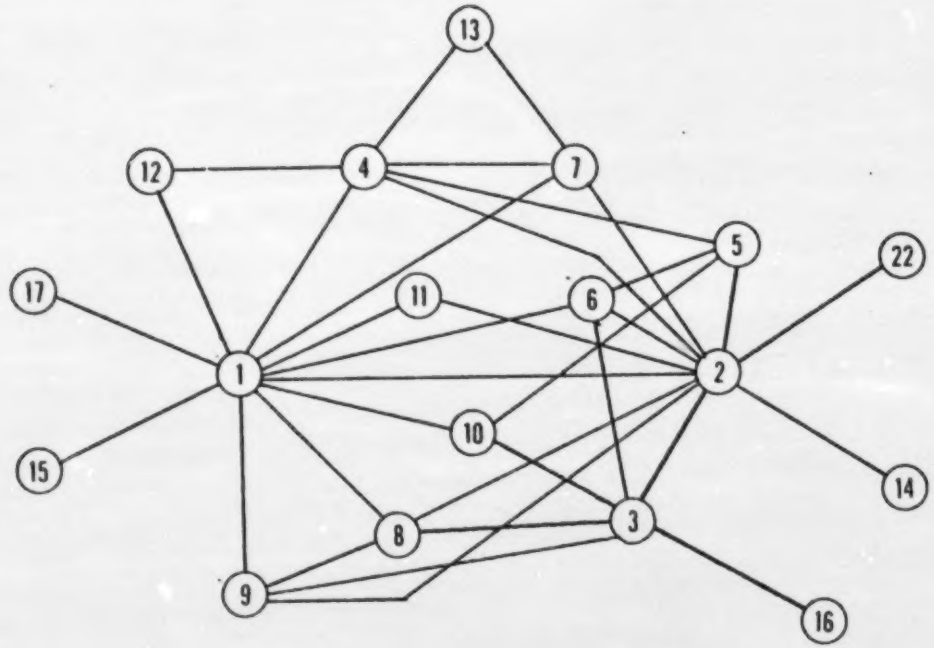
SPEAKER 5 PROFILE

ference, hosted by members of an undegraduate evaluation research methods course, taught by the author. The topic was to plan for future uses of communication technologies by members of ICA. Two students, Sue Sattell and Terry Olowu, network analyzed participants. Their objective was to investigate network and content structure relationships. For example, network groups that are more integrated may have more diverse content exchanged about the environment, less about the group and the communication system used, and more about one another, as indicated in research on face-to-face networks (Danowski, 1980).

Figure 4 shows the overall network of actors who addressed messages to specific people during the course of the computer conference. Messages adddressed to the entire group were treated as a different "layer" of conference interaction and not subject to network analysis. Each of the messages in the conference was content analyzed. Elemental concepts within messages were partitioned. Once the master list of elemental concepts was derived, then each message was coded as to its content. Next, all messages sent by a particular user were aggregated. Then a measure of diversity of content that each user sent was performed, using the information theory relative H statistic (Relative H= $p_i(\log_2 p_i)$ / $\log_2$ N ; where p_i is the proportion of all message content that a particular content category represents, and N is the total number of content categories (Danowski, 1974). To index network position, node integration was measured for each participant. This construct is the extent to which there are links among the contactees, or in other words, to which there are 2-step links among a node's contacts. The raw number of links: connectedness was also measured.

Once both sets of variables were constructed: 1)the content diversity measure, and 2)the network structure measures: connectedness and integration,

Figure 4. A Two-week Computer Conferencing Network among Members of a Professional Association.



data were correlated to test the hypothesis that the greater the node integration, the more diverse the message content. Results appear in Table 2. Even though sample size is small, there were some significant differences. Connectedness is significantly positively correlated with the simple number of different content categories represented in a user's messages and with the diversity (entropy) of content, controlling for the number of and absolute values of the content categories. This relationship, however, was not hypotheised a pricri. Integration is positively correlated with both content variables, and more highly with diversity than number of categories, but with the small n of 16, these coefficients did not achieve statistical significance. The main hypothesis was not supported.

Different kinds of content analysis could also be performed in conjunction with the network analysis. In fact, other students in the class, Terry Olowu and Lois Berg, performed a concept cooccurrence scaling across pairs of messages in this same conference and multidimensionally scaled them for three time segments, using the procedures outlined in another paper (Danowski, 1982).

COMPUTER MESSAGING TRAFFIC

The fourth example is analysis of private messaging among pairs of individuals in an organization. The organization has a headquarters with numerous branches and the electronic mail system is mainly used by headquarters personnel and by branch personnel to communicate about basic task operations. We captured all messages exchanged among approximately 350 users. In this particular analysis we selected a two month time segment of these mail exchanges from the 18 months of data collected. We also did a survey of users in which we asked them to estimate message traffic among randomly selected pairs of branches. These data were gathered as part of an evaluation research

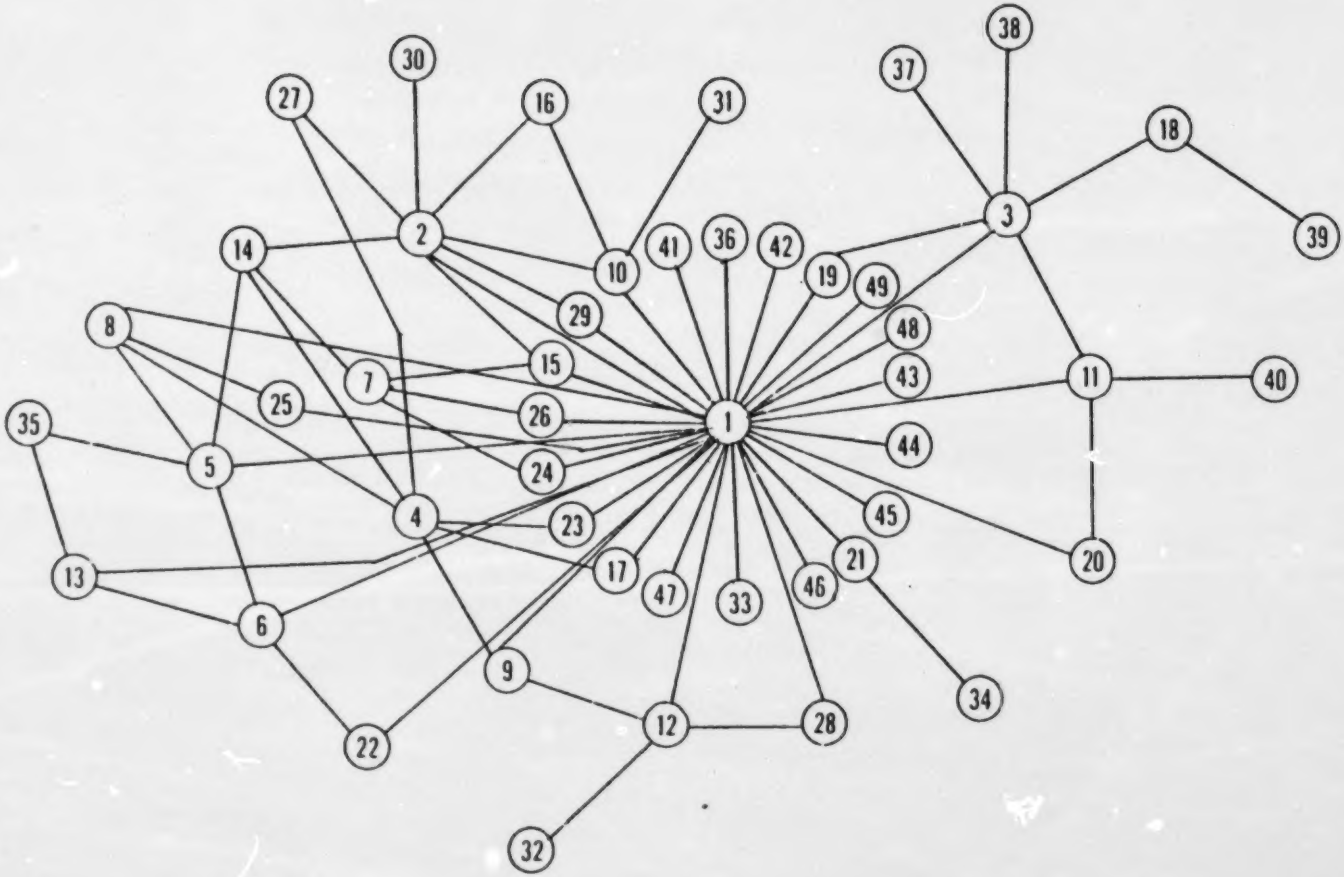
TABLE 2. Node Integration and Connectedness in Correlation with Message Content Diversity

	NUMBER OF CATEGORIES	CONTENT DIVERSITY
NODE CONNECTEDNESS (Number of Links)	.62*	.45*
NODE INTEGRATION	.22	.31

n=16

* $p<.05$

Figure 5. Private Electronic Mail Traffic Among Branches and Headquarters of an Organization over a Three Month Period



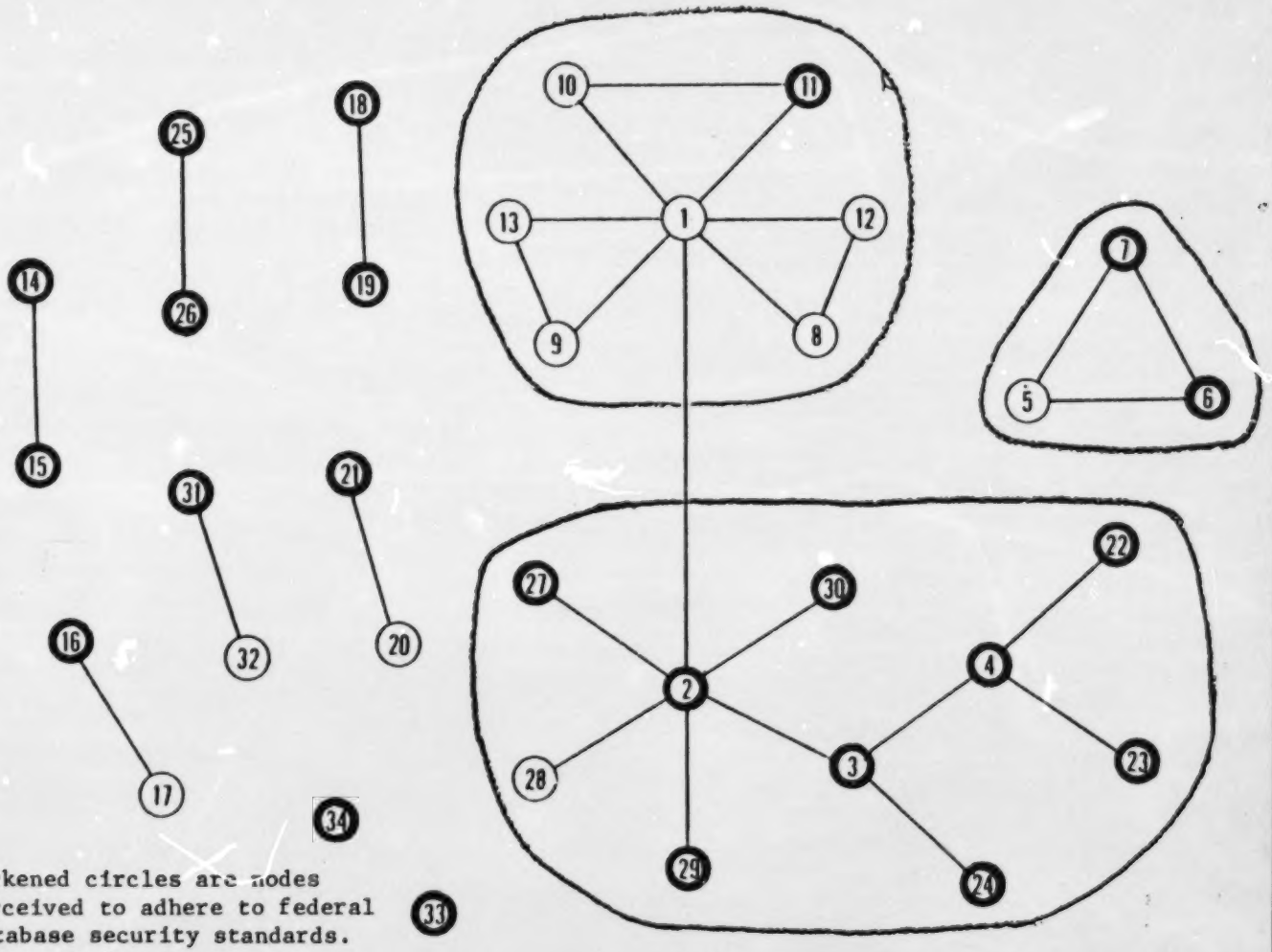
methods course. Don Schutt and Vonne Muessling worked with the author on this later analysis in a directed study course.

Figure 5 shows this network aggregated up from the individual pairs of users to the branch (and headquarters) level. The node is now this formal organizational unit. We did this particular analysis to see if nodes that were more central in the network had a more accurate mental picture of the actual network in other areas. We found that individuals in more centrally positioned organizational units tended to overestimate traffic in more peripheral regions of the actual network. In contrast, those on the periphery had a more accurate picture of the other peripheral traffic. The relationships, however, were not very strong, barely reaching statistical significance. In part this was because of the small sample size using organizational units as nodes. Nevertheless, this example illustrates use of automated communication network traffic to build higher order aggregated network representations.

MEDIA REPRESENTATIONS OF NETWORKS

The fifth set of examples are analyses of networks of actors as represented in news stories. These are "socially synthetic" networks. The examples are student projects from an undergraduate seminar about communication technologies taught by the author in 1981. One student, Eric Erickson, was interested in organizations' database security. He wanted to see if organizations that were more central in interorganizational networks were more likey to have adopted the data security standards recommended by the federal government, and whether groups of organizations adopted these standards based on their intragroup network characteristics. So, he used the NY Times Index subject categories for database topics and coded each time an

Figure 6. Adoption of Database Security Standards by Organizations represented in New York Times News Stories about Databases



NOTE: Darkened circles are nodes perceived to adhere to federal database security standards. Large circles denote groups.

KEY to Figure 6.

NODE NUMBER	ORGANIZATION
1	United States Justice Department
2	IBM
3	Bernay, Smith, Upham, Inc.
4	Sperry Univac Inc.
5	Brazilian Government
6	Honeywell Information System
7	Inspec
8	OPM Leasing Services
9	N.Y. Institute of Technology
10	Government Services Administration (GSA)
11	Computer Sciences Corp.
12	Cali Trading International, Inc.
13	Balmon Inc.
14	Quotron Systems Inc.
15	Beehive International
16	Data Products Corp.
17	American Airlines
18	U.S. Army
19	Norden Systems Inc.
20	Safeway Food Stores
21	MSI Data Corp.
22	Mitsubishi Heavy Industries
23	Mega-Data Corp.
24	NCR
25	Dow Jones and Company
26	Tandy Corp.
27	European Economic Community (EEC)
28	Greyhound Computer Corp.
29	Matsuishita, Inc.
30	Morgan Stanley Company
31	Control Data Corporation
32	University of Brock
33	Burroughs
34	Northern Telecom

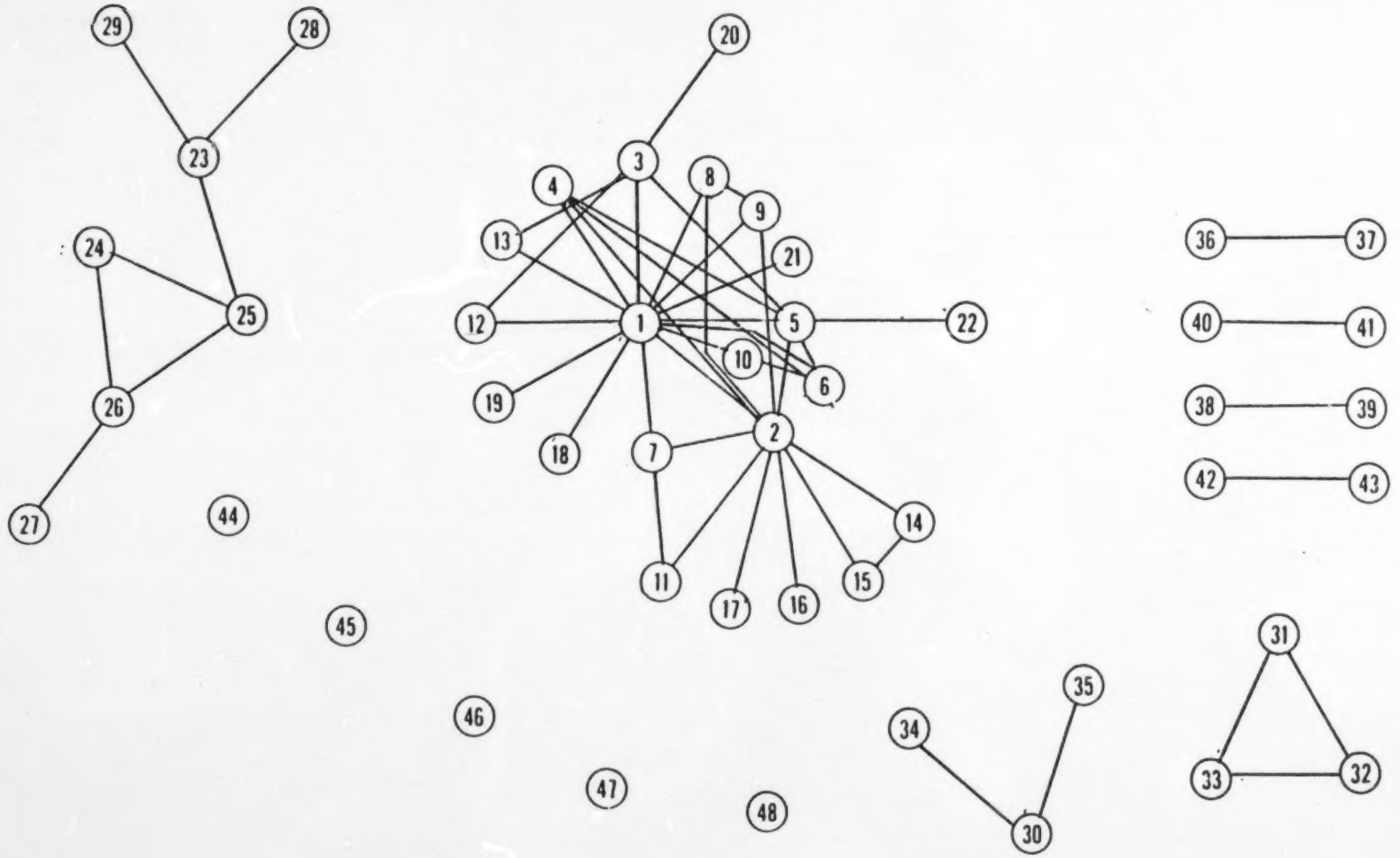
organization was mentioned in a news story in conjunction with another organization. He aggregated the within story cooccurrence of organizational actors across all stories for a 6 month period. Then he graphed the aggregated network among actors (See Figure 6).

He attempted to get information from each organization as to whether they currrently used various data security standards. But, given the time pressures in the semester, and possible respondent resistance to provide such data, he instead had Computer Science professors expert in data security estimate the extent to which they thought each organization used the standards. The student then proceeded to informally test his hypotheses. Figure 6 shows the network of actors.

Another student in the seminar used more automated capture of news story networks among organizational actors. Laurie O'Brien used data we recorded on a microcomputer as we were logged into an online data base on the DIALOG system (and others) called the National Newspaper Index, which at the time abstracted the New York Times, Wall Street Journal, and Christian Science Monitor. (Now, the Los Angeles Times and Washington Post are also abstracted). Each abstract lists the organizations and individuals named in the stories. She selected all stories having to do with electronic mail and developed the aggregated cooccurrence of actors across the sample of news stories.

Another student, Enid Vasquez, did a similar analysis of NY Times stories with respect to ATT disvestiture legal proceedings. And another student, Richard Eidlin, did an analysis with stories about satellite commmunication to investigate which organizations dominated and which formed groups, to test his hypothesis that govermental organizations would be more centrally positioned than private sector ones. Figure 7 shows his network graph.

Figure 7. Networks of Organizations represented in New York Times News Stories about Satellite Communication.



KEY to Figure 7.

NODE NUMBER	ORGANIZATION
1	Federal Communications Commission
2	RCA
3	COMSAT
4	NBC
5	AT&T
6	GTE
7	Federal Judge Tidwell
8	CBS
9	ABC
10	Canada
11	Ted Turner
12	National Telecommunications and Information Administration
13	National Association of Broadcasters
14	Bristol Connecticut
15	Premiere
16	MCI
17	Government Services Administration
18	Southern Baptist Convention, Radio & TV Commission
19	DBS
20	Radiation Systems
21	Western Union
22	Donnelly and Sons
23	Harris
24	IBM
25	Air Force
26	Hughes
27	Time, Inc.
28	Argentina
29	ARCO
30	Satellite TV Association
31	European Space Agency
32	Ariane
33	India
34	Mebia Pt
35	Universal Subscription TV
36	Associated Press
37	UPI
38	J C Penney
39	SBS
40	American Satellite Corp.
41	Federal Express
42	Rainbow Communications
43	Warner Amex Satellite Corp.
44	Satellite Broadcasting Co.
45	Burkhart
46	GENSAT
47	Westinghouse
48	World Trade Center

DISCUSSION

This final main section of the paper discusses several implications of automated communication network analysis at theoretical, methodological, and practical levels that have not been addressed in the introduction to this paper. The theoretical aspect comes back to the introductory points made about the seven different ways in which automated communication network analysis can be represented. Prior research has mainly centered on only two kinds of network representations, self-reported and other-reported, as seen in most of the Bernard and Killworth series of studies. "Objective" networks, made possible by automated data capture of communication traffic on computers or telephones, and to some extent via other media such as video conferencing, stimulate a broader range of theoretical ways to conceive of human communication. A subsequent theoretical need is to account for the correspondence rules that may link different representational networks. For example, what correspondence rules map "objective" with "social synthetic" network representations? In fact, with seven levels (and others may be identified) there are 21 different pairs of network representations that could be examined. It may be useful, however, to search for more parsimonious correspondence rules than might be developed on a pair-wise basis only.

At the methodological level some points to be discussed concern the changing feasibility of capturing all of an individual's computer-based message traffic. With the proliferation of systems and with micro-computers, as individuals use different communication services (ranging from those on TELENET to local CBBS bulletin-boards on micros), it is increasingly difficult to map each individual's networks across different systems.

Rather, what occurs is a redefinition of the units of data capture away

from the individual and toward the communication system, followed by an individual level node segmentation. To the extent that computer-based communication patterns are determined by system features, such segmentation is appropriate. Questions are far from resolved, however. They have barely been asked. The issue has been framed here as a methodological one, mainly because some analysts have wrestled with gathering network data from a series of distributed micro computers that some organizations increasingly use for messaging. Nevertheless, the issue have important theoretical significance.

These segmentation issues, however, could probably be short-circuited if most computer-based communication were to occur on centralized computers, whether mainframes or micros. But, with the explosion of personal computer (PC) messaging and bulletin board systems across the nation, a recentralization of messaging seems unlikely in the near term. In contrast, particular organizations have the choice as to what kind of computer communication systems to foster, whether to support messaging on a series of distributed micros, or on a centralized one (or larger computer). For purposes of monitoring and managing computer communication it would be desirable to have dedicated central computers for messages, so that traffic information could be efficiently obtained on these machines (micro or larger), rather than on a series of decentralized ones.

Other issues concern user privacy. To the extent that users are aware of automated traffic monitoring, and they choose to accept it and do not alter their behaviors substantially, then there is no major problem. But, if users are not aware, then ethical questions for the analyst arise. At the same time, if users change their behaviors because of monitoring, then this self-reflexivity presents research reactivity problems. Nevertheless, these are

much broader than research problems. Issues about computer-based privacy have been visible on the national public affairs agenda for more than a decade. And, the issues are likely to be repositioned upward on the agenda in the near term.

At a more concrete and methodologically challenging level are problems with the identity of network nodes. In automated data capture, there is typically no fully tractable procedure to verify node identity, (nor is there, by the way, typically such in traditional self-report research, unless ID cards are checked). For example, if a computer communication user logs in with another person's account and enters messages in a system as if he or she were actually the other person, then identity problems arise for the analyst. These problems are such that they are typically not knowable from the analyst's knowledge base. And it is quite likely that if one person uses the identity of another in messaging on a computer system, that the same behavioral patterns will not apply to both the true identity holder and the fraudulent one.

The identity problem is even more pronounced with telephone network analysis, using telephone number as the node. It is normal for multiple identities to use a single phone line. For improved automated data capture it would be desirable for organizations to assign each person a unique phone number and to include specific passwords for use, such as occur on many of the digital telephone PBX systems that are increasingly used to control long-distance costs and provide enhanced call functions and voice-data integration.

Finally, with all the popular discussion of the "networking society" (Naesbit, 1982) there is a corresponding explosion in opportunities for communication researchers to evolve communication network analysis beyond the levels

characteristic in the 1970's. During that period, the development of analytical software expanded theoretical work mainly in organizational and development communication areas. Now, it is possible to move network theorizing up another major notch on the ladder of abstraction to account for a greater range of relational communication, including organizational and development communication, along with informal person-centered networks in and across "home" settings, mass media reports of societal relations, and a range of other domains. This paper has shown some of the possibilities in these areas, but largely from a demonstration and not a knowledge building basis. The promise of automated network analysis for enabling the construction of more parsimonious and wide-scope communication theory is now more visible.

SUMMARY

This paper has focused on automated communication network analysis. Seven different approaches to defining networks, including several automated ones, were discussed. In addition, advantages of automated network analysis were considered, as well as disadvantages. To illustrate possible forms and uses of automated communication network analysis, five different kinds of examples of such analyses were described. Finally, issues concerning automated network analysis at the theoretical, methodological, and practical levels were discussed. Automated communication network analysis appears to offer promise for communication theory, research and practice, provided that certain limitations are considered. Future trends in automated network analysis were highlighted.

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